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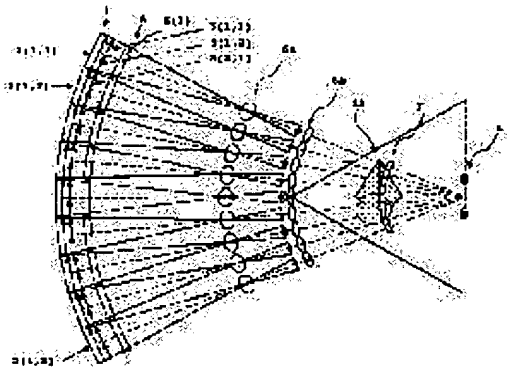
(54) STEREOSCOPIC IMAGE REPRODUCING DEVICE AND METHOD THEREFOR

(57)Abstract:

PURPOSE: To view an excellent stereoscopic image having many parallaxes in a wide observation area by using the conventional general image display device.

CONSTITUTION: The planar image consisting of a picture element provided with parallax image units in which the number of viewing points in a 1st direction is more than that in a 2nd direction is formed, and enlarged or reduced to be projected by anamorphic optical systems 5 and 6a having magnification independent in the 1st and the 2nd directions, so that the aspect ratio of the image and the reproduced image is perfectly controlled.



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2.**** shows the word which can not be translated.
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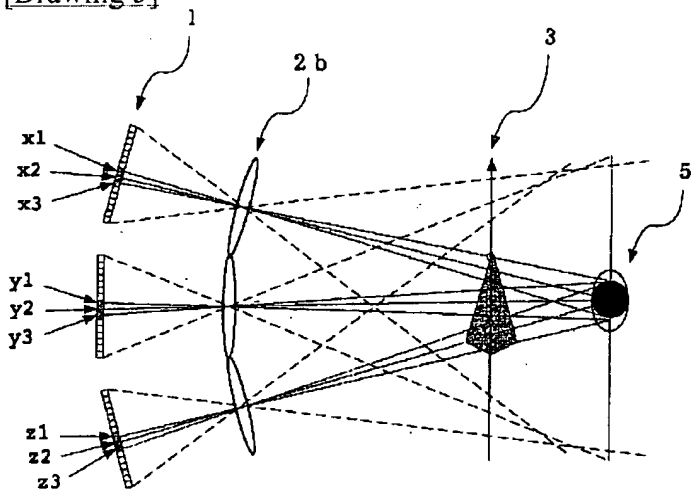
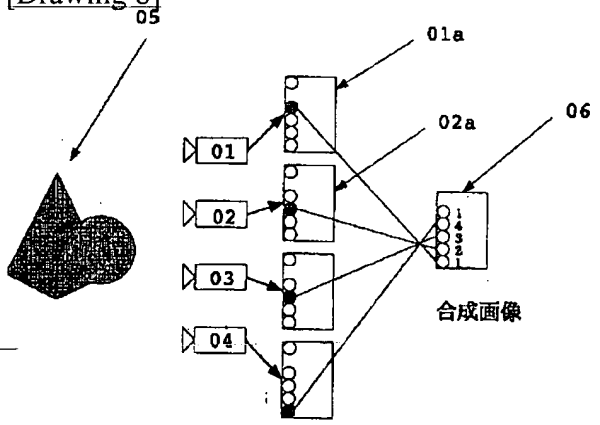
DRAWINGS

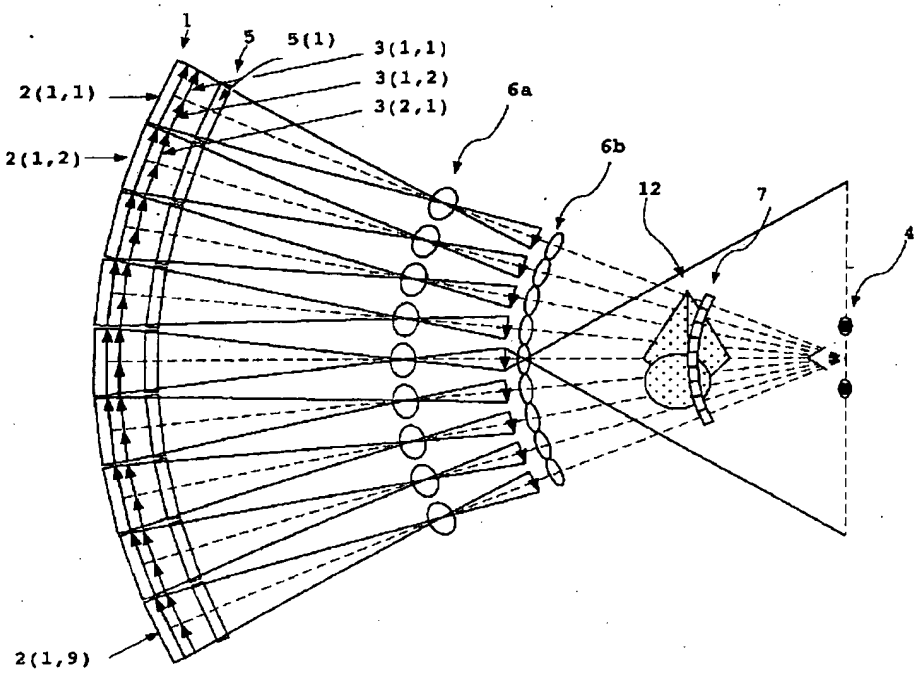
[Drawing 5]



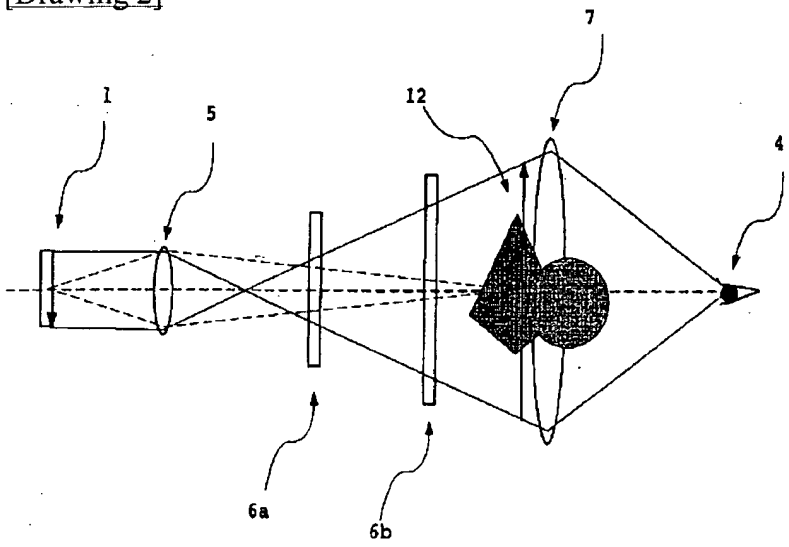
[Drawing 8]



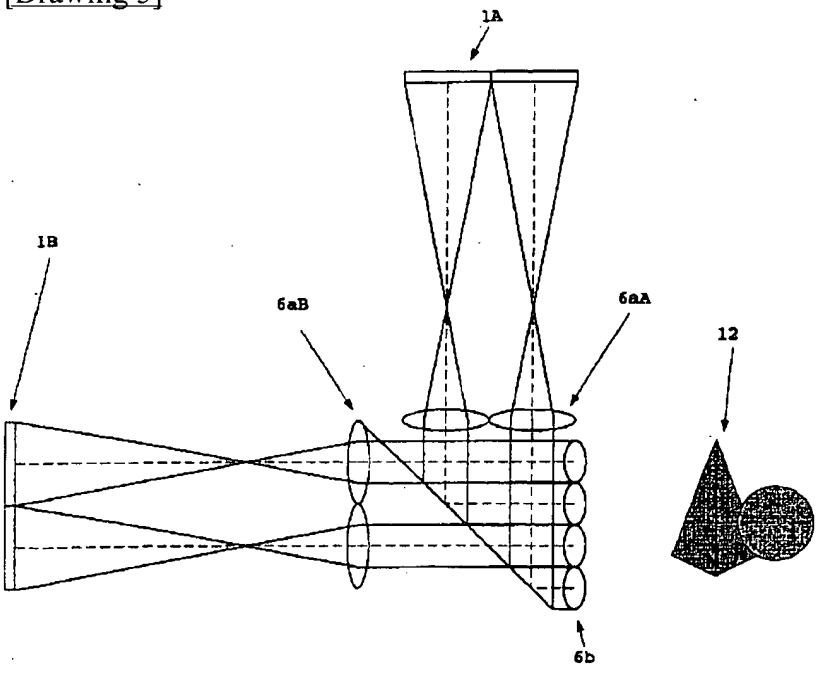
[Drawing 1]



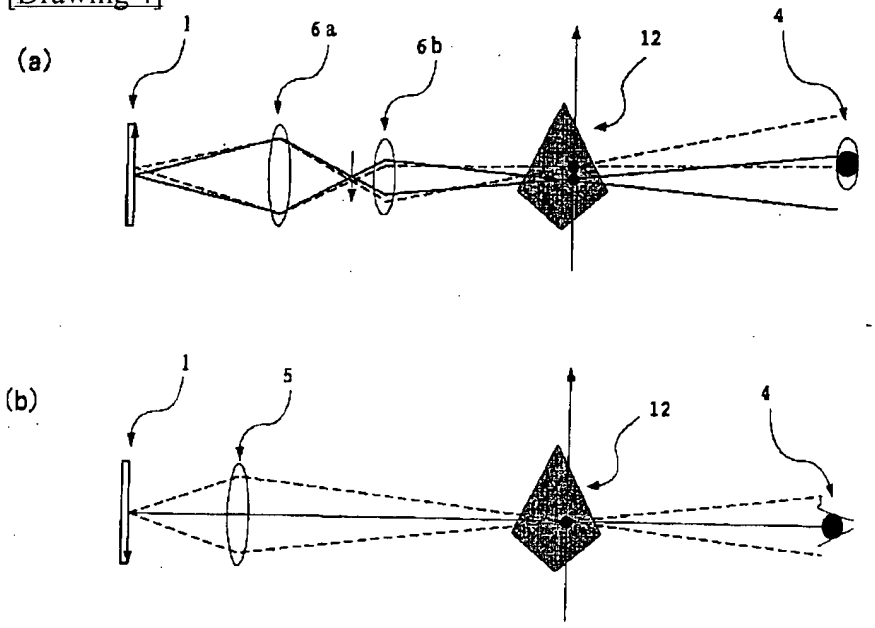
[Drawing 2]



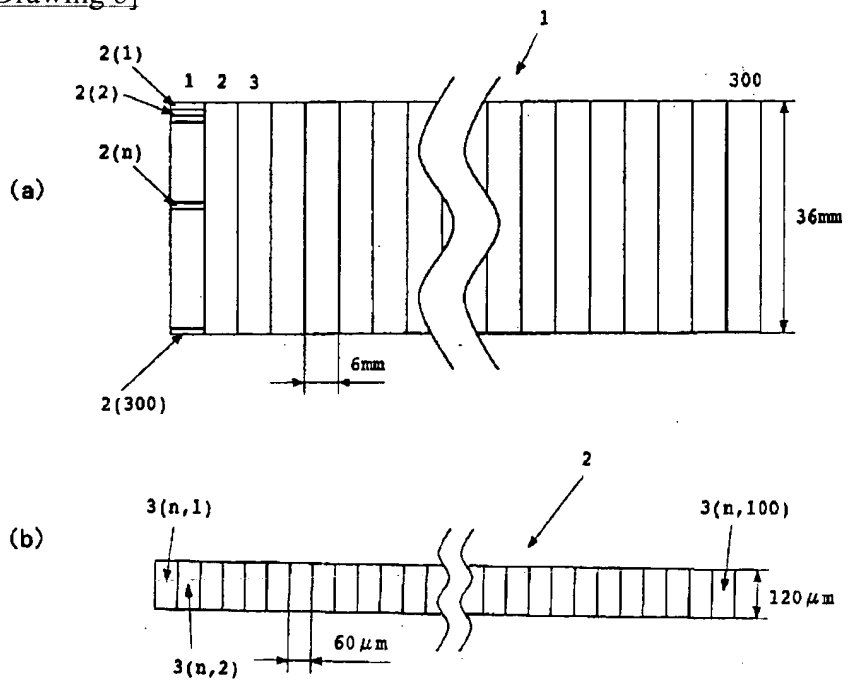
[Drawing 3]



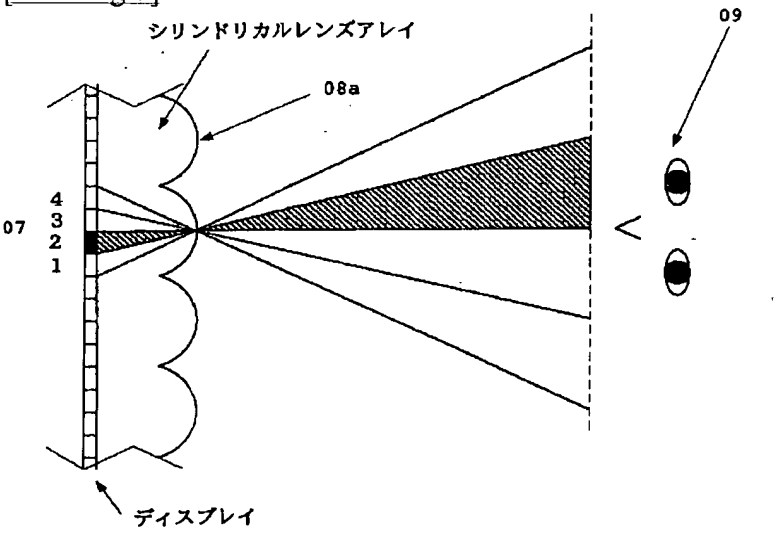
[Drawing 4]



[Drawing 6]

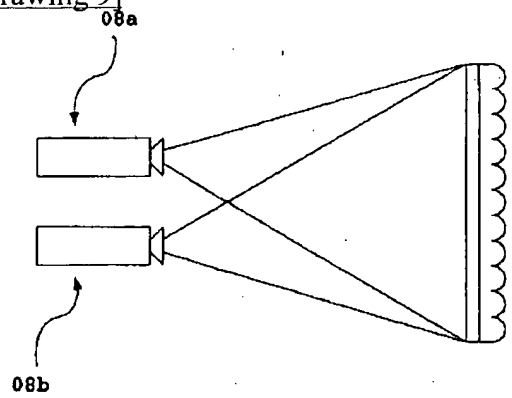


[Drawing 7]

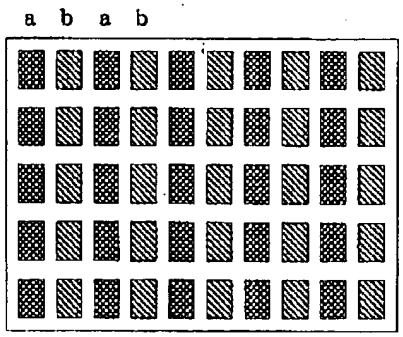


[Drawing 9]

(a)



(b)



[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is the top view showing the example 1 of the stereoscopic model regenerative apparatus of this invention.
[Drawing 2] Drawing 2 is the top view of drawing 1 .
[Drawing 3] Drawing 3 is the top view showing other examples 2 of the image playback approach.
[Drawing 4] Drawing 4 is the conceptual diagram showing the example 3 of the stereoscopic model regenerative apparatus of this invention, and the top view in which drawing 4 (a) shows horizontal optical system, and drawing 4 (b) are the front views showing vertical optical system.
[Drawing 5] Drawing 5 is optical drawing for explaining an operation of an example 3.
[Drawing 6] Drawing 6 shows the field-like playback image formation object of an example 1, and the front view in which drawing 6 (a) shows the whole surface of an image formation object, and drawing 6 (b) are the front views showing a parallax image unit.
[Drawing 7] Drawing 7 is optical drawing showing the well-known principle of the conventional stereoscopic model regenerative apparatus of a lenticular method.
[Drawing 8] Drawing 8 is an optical block diagram for explaining the image composition by the well-known principle.
[Drawing 9] Drawing 9 is the top view of the approach of raising the image consistency based on a well-known principle, and drawing 9 (a) is a top view and the drawing 9 (b) side elevation.
[Description of Notations]
1 -- Field-like playback image formation object
2 (1 n) Two (n) -- Parallax image unit
3 (n, m) -- Pixel
5 -- The 1st perpendicular direction cylindrical lens
6a -- The 1st horizontal direction cylindrical lens
6b -- The 2nd horizontal direction cylindrical lens
7 -- Cylindrical lens

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to stereoscopic model regenerative apparatus, such as Stereo TV and the image transcription type stereo TV. Furthermore, it is related with the lenticular type stereoscopic model regenerative apparatus for irradiating the exposure light for playback in detail at the parallax planar image photoed and restored with two or more cameras, and reproducing the feeling image of three-dimension stereoscopic vision using a cylindrical lens.
[0002]
[Description of the Prior Art] The approach using glasses as the solid image reconstruction approach is learned. This approach is an approach of separating and carrying out incidence of the parallax image of a repeat display image to right-and-left both eyes through polarization glasses and liquid crystal shutter type glasses. Since troublesome special glasses are needed, this approach is disliked. Moreover, since an image does not change even if an observer (those who look at TV) moves both eyes horizontally and this approach moves a view, a cubic effect is unnatural, and TV with a true cubic effect like a hologram method cannot be constituted.
[0003] As other solid image reconstruction approaches, there is a hologram method which uses laser as the light source for playback. This approach with excessive amount of information needs the display of the resolution which can think by the light and can write in 1000 thin lines in 1mm width of face, and cannot realize it with the present image display means. The lenticular method is learned as an approach a cubic effect in the case of usually moving a view with the amount of information of extent not using glasses is also realizable.
[0004] The integral photography which is the principle of a lenticular method is advocated by Lippmann in 1908. This lenticular method is detailed to the Ogoshi ****** "three-dimensions image engineering (Asakura Publishing issuance)." As it is expressed to drawing 7 which shows the case of 4 eye type, and 8, if it introduces to need extent The subject-copy image 05 which is a photographic subject is separately photoed with four isolated cameras 01, 02, 03, and 04. These photography images (for example, black dot image formed in that of each pixel of the CCD side of the CCD camera tube) 01a, 02a, 03a, and 04a are compounded in one unit of the location corresponding to a camera of 1 unit pixel of the regenerative apparatus 06, such as liquid crystal, and it reproduces.
[0005] Thus, the include-angle gap to the photographic subject 05 of a camera is expressed in general as a location gap of a regenerative apparatus 06. If the number of a camera is made to increase, a response with an include-angle gap of a camera and a location gap of the pixel within 1 parallax image unit of a regenerative apparatus will become accuracy more (stereoscopic vision resolution becomes good). Per two or more parallax image of a regenerative apparatus, the pixel from each camera is reproduced in loop sequence. Such a synthetic image is shown in drawing 7 as 1 parallax image unit 07. Corresponding to 1 parallax image unit, one unit lens (unit cylindrical lens) 08a is prepared 1 pixel ahead (to observer side).
[0006] The light irradiated by the liquid crystal of the black-lacquered No. 2 pixel in 1 parallax image unit is scattered about and penetrated, passes along lens 08a, and goes the inside of a slash field straight on. The light irradiated by the liquid crystal of the No. 3 pixel in 1 parallax image unit is scattered about and penetrated, passes along lens 08a, and goes the inside of another field (inside of the field of the next door of said slash field) straight on. It separates into the eyeball 09 on either side, and incidence of dispersion and the transmitted light of each watch unit is carried out. If an eyeball 09 is moved up by drawing 7 , dispersion and transparency of dispersion and the transmitted light of a No. 1 pixel, and a No. 2 pixel will be separated, and incidence will be carried out to both eyes 09.
[0007] Although such a lenticular method gives horizontal solid information, it does not give the solid information on the direction of a vertical. The effectiveness of solid information becomes settled by the design constant which is correlation of the separation of an observer's observation location (sight distance), the distance between both eyes, liquid crystal display width of face, and two or more cameras etc. An observation field is expanded by the increment in the number of views, and the increment in the number of pixels, and a cubic effect becomes natural.
[0008] In order to increase the number of views, the relation between the pitch of the lenticular sheet which forms a lens

in the shape of a stripe, and the number of pixels in 1 pitch is taken into consideration. If the pitch is fixed, it is necessary to make the pixel consistency of a display high and to make [many] the number of pixels. On the contrary, if the pixel consistency and the number of pixels of an indicating equipment are fixed, it is necessary to make one pitch of a lenticular sheet coarse. The resolution of a solid image falls and it becomes impossible for this reason, to reproduce a good solid image.

[0009] Amount of information required for the display in the display for playback is the product of the number of pixels of a parallax image, and the number of views. If the vertical number of views is disregarded and the horizontal number of views is set to 100, it is necessary to increase horizontal amount of information 100 times to vertical amount of information. In order to make equal resolution of the both directions of a playback solid image, it is necessary to increase a horizontal pixel consistency 100 times to a vertical pixel consistency. Conversely, when it says, the quality of the display image for playback in a regenerative apparatus will be restricted by the horizontal pixel consistency.

[0010] The proposal for solving this point is proposed with "8 Eye-type-glasses-less 3-D TV display system" of a three-dimension image conference and the lecture collected works 2-4 of 93. This proposal is the approach of compounding the image of each projector using two sets of projectors, and making a pixel consistency high seemingly, as shown in drawing 9 . This approach is applicable also to a liquid crystal video projector with the black matrix of the optical nontransparent nature which is a clearance for wiring etc.

[0011] For example, as shown in drawing 9 (b), the clearance between the pixels of the display image formed by one projector is pixel-ized, other parallax images are displayed by the projector of another side, other parallax images formed by the pixel of a parallax image and the projector of another side which are formed by one projector are horizontally arranged in by turns, and two parallax images are compounded. Moreover, how to compound three or more parallax images using a half mirror is also learned for this approach.

[0012]

[Problem(s) to be Solved by the Invention] According to such amelioration that superimposes a pixel using the protection-from-light field between pixels, whenever [superposition] is decided by the numerical aperture of a pixel. Whenever [superposition] is 2 if a numerical aperture is 50%. If a numerical aperture is made low in order to raise whenever [superposition], the rate for Mitsutoshi of the screen will be lowered and the brightness of a screen will be reduced. One pixel will become the special configuration of being perpendicularly long and slender further again.

[0013] Since it is such, the existing common display cannot be used, but the display of special dedication needs to be developed and there is a difficulty in respect of cost. Such a difficulty is not restricted to LCD but is also in CRT and a plasma display. Thus, since there is a limitation in making a pixel consistency high, the number of views is made to increase, without lowering the horizontal resolution of the solid image to reproduce, and there is a trouble that it is difficult to constitute the display of the image for playback for obtaining a natural solid image. This invention is made based on such a technological background, and attains the object which carries out the following.

[0014] The object of this invention is to offer the stereoscopic model regenerative apparatus which can reproduce a good stereoscopic model with much parallax. The object of this invention is to be able to reproduce a good stereoscopic model with much parallax, and offer a stereoscopic model regenerative apparatus with a large observation field. Other objects of this invention are to be able to reproduce the good stereoscopic model which could use the common image display device of a conventional-type, and had much parallax, and offer a stereoscopic model regenerative apparatus with a large observation field. The object of this invention is to offer the stereoscopic model playback approach which can reproduce a good stereoscopic model with much parallax.

[0015]

[Means for Solving the Problem] The following means are taken in order to solve said technical problem. Namely, the field-like playback image formation object of the picture reproducer with which this invention reproduces two or more parallax images (1), It consists of optical system arranged among said field-like playback image formation objects (1) and observers. Said field-like playback image formation object (1) Constitute the unit of the pixel (2) located in a line in the 1st direction and the 2nd direction, and said pixel (2), and it becomes the parallax of list plurality from the parallax image unit (3 (m, n)) corresponding to each in said 1st direction. Said optical system consists in the stereoscopic model regenerative apparatus which is an anamorphic optical system (5 6a) for expanding or reducing said parallax image unit (3 (m, n)) of said pixel (2) according to an individual in said 2nd direction for the scale factor which became independent to said 1st direction.

[0016] And it consists in the stereoscopic model regenerative apparatus which, on the whole, expands the image of a field-like playback image formation object (1) in said 1st direction, and reduces said parallax image unit (3 (m, n)) according to an individual in said 2nd direction in a stereoscopic model regenerative apparatus again.

[0017] And the image plane which includes the outline core of the playback image formed of said anamorphic optical system (5 6a) in a stereoscopic model regenerative apparatus again, and said field-like playback image formation object (1) consist in the stereoscopic model regenerative apparatus in image formation physical relationship.

[0018] And it consists in the stereoscopic model playback approach which consists of an optical projection process which

expands or contracts by the anamorphic optical system (5 6a) which the scale factor became independent of, and projects said image in the optical image-formation process which forms the image of the shape of a field which consists of a pixel equipped with a parallax image unit with more views of the 1st direction than the number of views of the 2nd direction again, and said 1st direction and said 2nd direction of said.

[0019]

[Function] The stereoscopic model regenerative apparatus and its stereoscopic model playback approach of this invention have longitudinal magnification (the 1st direction scale factor) and independent lateral magnification (the 2nd direction scale factor) by the anamorphic optical system. Two or more 1 parallax images located in a line with a longitudinal direction for every 1 parallax image unit are expanded or reduced to a longitudinal direction. The solid image of a different pixel consistency in every direction from the pixel consistency of a playback image formation object in every direction is reproduced.

[0020]

[Example]

(Example 1) Next, the example of this invention is explained. The number of views is plurality in a horizontal direction or the 1st direction, and the number of views of the example 1 of the stereoscopic model regenerative apparatus of this invention is an unit in the direction of a vertical (it says perpendicularly hereafter), or the 2nd direction. Drawing 1 is notionally shown, although it is the flat-surface sectional view in which cutting in a certain height location in the level surface, and showing the example 1 of the stereoscopic model regenerative apparatus of this invention. The field-like playback image formation object 1 which is the display of picture reproducer is the display screen of a liquid crystal activity which is used for TV of common knowledge common use for example.

[0021] The field-like playback image formation object 1 has the matrix-like pixel in all directions. Die length in every direction is in a phase etc. by carrying out temporarily now, and the display screen presupposes that it is a square screen. A pixel consistency is in every direction and equal. Since the number of views is 1 in a lengthwise direction, the cross-section structure cut with the vertical plane shows only 1 parallax image unit to drawing 2 . As shown in drawing 1 , the number of the parallax image unit 2 (1 n) horizontally located in a line is temporarily set to 9 from the facilities for expressing to a drawing.

[0022] It is shown that 1 of the figure in a parenthesis is a parallax image unit included in one train of a certain height location. The central parallax image unit 2 is shown by 2 (1 5). Per [2] each parallax image, the image which copied the photographic subject with two or more cameras is put in order horizontally, and it is reproduced. Therefore, 1 parallax image unit consists of further two or more pixels. As mentioned later, in this example 1, the number of the pixels within 1 parallax image unit is 100.

[0023] Although this unit pixel is expressed with 3 (1 n, m), when the number of views is 1, since the information 1 in three (1 n, m) does not have technical meaning, perpendicularly, it is only expressed with 3 (n, m) below. That is, per 1 parallax image, there are 100 pixels written by 3 (n, 1), 3 (n, 2)-3 (n, 100). The photography image also according [which parallax image unit] regardless of a list and the value of n to 100 cameras of the same sequence as these 1-100 numbers as 1 and the sequence of 2...100 corresponds.

[0024] For example, a pixel 3 (3 12) and a pixel 3 (5 12) are the reconstruction images of the image photoed with the camera (it is the same) of the same location. It is referred to as m= 2 for the facilities of explanation. About the parallax image unit 2 (1 1), each reconstruction image 3 reproduced per parallax image (1 n) 3 (1 1) and 3 (1 2), It expresses [unit / 2 (1 2) / parallax image] with 3 (9 1) and 3 (9 2) about 3 (2 1), 3 (2 2), and the parallax image unit 2 (1 9).

[0025] For example, when the cylindrical photographic subject which is horizontally suitable is copied with two cameras, there is no reconstruction image in the pixels 3 (7 2), 3 (8 2), and 3 (9 2) for playback corresponding to the image of one of the cameras with which projection die length differs. The device of the common knowledge common use corresponding to whether the electrical potential difference is applied to whether there is any reconstruction image or there is nothing, and a liquid crystal device or that is not right is used. The short arrow showed the image of one pixel of these pixels 3 next to the large arrow for convenience on the concept at drawing 1 .

[0026] The direction which turns on the observer who shows at one pair of eyeballs or a pupil 4 from the field-like playback image formation object 1 is called front. The 1st perpendicular direction cylindrical lens 5 which had power in perpendicularly [two or more] it has magnifying power (one or more scale factors) perpendicularly at the front-face side of the field-like playback image formation object 1, and 5...5 are horizontally prolonged in each. Since the field-like playback image formation object 1 has curvature, it has turned at the 1st perpendicular direction cylindrical lens 5 concentrically on the field-like playback image formation object 1 at parallel.

[0027] Although the one 1st perpendicular direction cylindrical lens 5 shown in drawing 1 is shown by the configuration which was expressed notionally and cut in order to show one pitch mentioned later, it is one continuum. The cross-section configuration of the one 1st perpendicular direction cylindrical lens 5 is expressed to drawing 2 . As for drawing 2 , only one vertical unit is shown. Two or more 1st perpendicular direction cylindrical lenses 5 are formed in the shape of a sheet by resin shaping, and are mass-produced.

[0028] Although each 1st perpendicular direction cylindrical lens 5 has a lens operation of magnifying power perpendicularly, it does not have a lens operation horizontally. The lens with such an operation was named the perpendicular direction cylindrical lens as above-mentioned. The one 1st perpendicular direction cylindrical lens 5 consists of nine units, as shown in drawing 1 .
[0029] Each one unit of every of the 1st perpendicular direction amplification cylindrical lens 5 corresponds per each [of the parallax image unit 2]. 5(1)5(2) -5(9) shows each unit. The horizontal cylindrical lens 6 by which each unit is arranged, and 6...6 are prepared at each on the straight line which connects each unit of the 1st perpendicular direction cylindrical lens 5, and the midpoint of a stereoscopic model observation field. The horizontal cylindrical lens 6 and 6...6 are a set of two lens systems because of the device mentioned later.
[0030] Each is called back 1st horizontal direction cylindrical-lens 6a and front 2nd horizontal direction cylindrical-lens 6b. 1st horizontal direction cylindrical-lens 6a is a lens which has a cutback scale factor. In addition, a scale factor is a scale factor generally said about a scaling operation of a consequent image, and it is not based on a strict definition. the -- the [1 horizontal cylindrical-lens 6a (n) and] -- 2 horizontal cylindrical-lens 6b (n) is prepared per [2 (1 1)-2 (1 9)] parallax image corresponding to 1 to 1.
[0031] the [the parallax image unit 2 (1 n) and] -- the [1 horizontal cylindrical-lens 6a (n) and] -- 2 horizontal cylindrical-lens 6b (n) and the midpoint of said stereoscopic model observation field are arranged on the same optical axis. Each 1st horizontal direction cylindrical-lens 6a and each 2nd horizontal direction cylindrical-lens 6b are prolonged perpendicularly, and are one followed each. As for the cross section by the flat surface which intersects perpendicularly with an optical axis, where is the same configuration.
[0032] The group of 1st horizontal direction cylindrical-lens 6a horizontally located in a line and the group of 2nd horizontal direction cylindrical-lens 6b horizontally located in a line as well as the group of the 1st perpendicular direction cylindrical lens 5 are formed in each with the sheet of one sheet. every from the convenience mentioned later -- the -- the posterior focal point of the unit of 2 horizontal cylindrical-lens 6b (n) -- every -- the -- the real image of the field-like playback image formation object 1 by 1 horizontal cylindrical-lens 6a (n) positions, and is carried out.
[0033] The 2nd perpendicular direction cylindrical lens 7 by which each unit is arranged, and 7...7 are prepared at each on the line of each unit of 2nd horizontal direction cylindrical-lens 6b, and the midpoint of a stereoscopic model observation field. The 2nd perpendicular direction cylindrical lens 7 is a field lens, and does not mean the amplification on a scale factor. What is necessary is just to have the vertical condensing function. Amplification condensing of the image on the field-like playback image formation object 1 is carried out by the 1st perpendicular direction cylindrical lens 5 and the 2nd perpendicular direction cylindrical lens 7, and an observer sees.
[0034] The group of the 1st and 2 perpendicular direction cylindrical lenses 5 and 7 and the group of the 1st and the 2 horizontal cylindrical lenses 6a and 6b constitute one anamorphic optical system. the [moreover,] -- between 2 horizontal cylindrical-lens 6b and the field-like playback image formation objects 1 -- the [the 1st perpendicular direction cylindrical lens 5 and] -- other one anamorphic optical system which consists of 1 horizontal cylindrical-lens 6a is interposed. As for such an anamorphic optical system, only the number of the parallax image unit 2 is constituted.
[0035] Next, an operation of an example 1 is explained. Although drawing 1 simplified for conceptualization and 2 are referred to, a numeric value is brought close to an actual thing, and explains an operation of an example 1. It is about 3m, the distance, i.e., the observation distance, between a pupil and the field-like playback image formation object 1. The pixel structure of the field-like playback image formation object 1 is as follows when using a commercial liquid crystal display as it is.
[0036] Drawing 6 (a) and (b) show the parallax image unit 2. As the parallax image unit 2 is shown in drawing 6 (b), 100 pixels 3 (n, 1)-3 (n, 100) whose 120-micron horizontal die length perpendicular direction die length is 60 microns are horizontally located in a line. In this case, perpendicular direction die length is [120 microns and the horizontal die length of the parallax image unit 2] 6mm.
[0037] As the field-like playback image formation object 1 is shown in drawing 6 (a), it has located in a line such a parallax image unit 2 300 pieces at a time further in all directions. In this case, perpendicular direction die length is [36mm and the horizontal die length of the field-like playback image formation object 1] 180cm. Although the pitch of a lens has 3 desirablemm or less in order to make it not not much highlight a vertical grid pattern, it explains as 3mm here.
[0038] Moreover, explanation can be simplified if each parallax image unit 2 of the field-like playback image formation object 1 is made to carry out image formation to the anterior focal point of 2nd horizontal direction cylindrical-lens 6b. Therefore, it designs to optical system in which a 3mm [per pixel] real image is horizontally formed just before 2nd horizontal direction cylindrical-lens 6b. Since the parallax image of 100 views is formed per 1 parallax image, as for the horizontal width of face of a pixel, an image with a width of face of 30 microns is formed.
[0039] It designs so that the image of a horizontally comparable pitch may be formed perpendicularly in homotopic. For example, 1-pixel spacing is set to 3mm. The horizontal and vertical smallest unit pixel in front of 2nd horizontal direction cylindrical-lens 6b (it is in agreement with a horizontal pixel) is the formed image in which scaling was carried out by the anamorphic optical system which the pixel of the field-like playback image formation object 1 becomes from the 1st

perpendicular direction cylindrical lens 5 and 1st horizontal direction cylindrical-lens 6a.
[0040] current -- if the example 1 of this invention shall be constituted using the liquid crystal display which had 60 microns in the available above-mentioned horizontal direction, and had the pixel pitch of 120 microns perpendicularly -- horizontal -- scale factors 1/2 and a perpendicular direction -- as the different directivity scale-factor optical system of a scale factor 25 -- the [the 1st perpendicular direction cylindrical lens 5 and] -- the anamorphic optical system which consists of 1 horizontal cylindrical-lens 6a is designed. Such optical system has the design constant which can be satisfied practical.
[0041] According to such a different directivity scale factor that has a scale factor for every 1 pitch unit or 1-pixel unit, refreshable image size is calculated as follows. Refreshable image size is 300(individual) x3(mm) =900(mm) horizontally from the optical-system unit of the part of the number of the image solution image points being horizontally required. Since it does not have parallax perpendicularly, a reconstruction image is an image by which amplification projection is simply carried out in the field-like playback image formation object 1.
[0042] Since it is 25 times the scale factor of optical system of this, perpendicularly, refreshable image size becomes 300 (pixel) x120(micron) x25=900mm. However, since the aspect ratio of the display with common horizontal length is 16:9, the dilation ratio of a actual perpendicular direction is not 25, and is good at 14 of a value smaller than this. Moreover, since a three dimentional display location becomes ahead [of optical system], the image playback range receives a limit at the include angle an observer expects optical system to be, and becomes small slightly from this value at accuracy.
[0043] The pixel 3 of an unit area with a breadth of 60 microns is in the parallax image unit 2 by 100 unit **** horizontally. For example, the 1st perpendicular direction cylindrical lens 5 is perpendicularly expanded to each 25 times, 1st horizontal direction cylindrical-lens 6a contracts to one half, and image formation of a pixel 3 (40 35) and the pixel 3 (40 65) is carried out to the anterior focal point of 2nd horizontal direction cylindrical-lens 6b as a real image with a breadth of 30 microns. On account of explanation, pixels 3 (40 35) and 3 (40 65) are permuted by the pixels 3 (5 1) and 3 (5 2) of drawing 1 , and are explained with reference to drawing 1 .
[0044] these pixels 3 (40 35) and 3 (40 65) -- the -- it goes straight on in the flare field 11 which spreads in 3 angle configuration with a top view by 2 horizontal cylindrical-lens 6b. the light (for example, although it is the scattered light, when that is not right, it mentions later) which came out of pixels 3 (40 35) and 3 (40 65) -- the -- it is separated into right and left by the unit lens of 2 horizontal cylindrical-lens 6b, and is alike, respectively, and incidence is carried out to left-hand side pupil 4L and right-hand side pupil 4R. The parallax real image 12 is formed on the way. The cylindrical lens 7 is formed for condensing to a pupil.
[0045] Drawing 2 shows the image formation relation between the field-like playback image formation object 1 and a solid image formation location about the perpendicular direction. The display image of the field-like playback image formation object 1 is expanded by the 1st perpendicular direction cylindrical lens 5. A field parallel to the field-like playback image formation object 1 and the field-like playback image formation object 1 are considered as image formation relation including the outline core of a stereoscopic model.
[0046] The flat surface which has the field-like playback image formation object 1 and an image formation relation including the outline core of a stereoscopic model is called image plane. If it does not fade and the point which doubles a focus and has an image on an image plane is observed, a gap of a congestion location and a focus location becomes min, and can observe an image with little sense of incongruity. Incidence of the whole stereoscopic model 12 light of a from is carried out to a pupil by the cylindrical lens 7, and the whole image can be observed.
[0047] By arranging the perpendicular direction diffusion plate represented by the lenticular sheet instead of a cylindrical lens 7, the field which observes an image is expandable. 1st horizontal direction cylindrical-lens 6a of the above-mentioned example 1 which has arranged the lens for every parallax image unit, constructed cutback optical system for every parallax image unit, and constituted the unit optical unit Since one piece is used for one unit optical system, it can be made the size of a reconstruction image on parenchyma at the thing of unrelated magnitude, and even if it becomes a large-sized screen, width of face and die length do not have to enlarge size of 1st horizontal direction cutback cylindrical-lens 6a.
[0048] Moreover, since an optical path is formed within each unit optical system, the optical system which does not have brightness nonuniformity in the whole image can be constituted by establishing the light source for every pixel. Since each unit image is carried out composition and image formation by composition of the beam of light which passed along the same narrow optical path further again, lens distortion prevents degradation of image quality few, and makes image quality good. If the above is explained to reverse, with a unit optical unit, enlargement of a lens will be prevented and enlargement of a screen will be made easy.
[0049] However, as a compromise, the unit optical unit in every two or more pixels may be formed. If the field-like playback image formation object 1 of a transparency mold is irradiated with the beam of light converged on the anterior focal point of 1st horizontal direction cylindrical-lens 6a, the beam of light which passes 1st horizontal direction cylindrical-lens 6a will turn into a parallel ray. If it is more than the size of the parallax image to which the size of 2nd horizontal direction cylindrical-lens 6b was reduced, all beams of light carry out incidence to 2nd horizontal direction

cylindrical-lens 6b, and the utilization effectiveness of an exposure beam of light is high.
[0050] In this case, said image formation relation to which the anterior-focal-point side of 2nd horizontal direction cylindrical-lens 6b is made to carry out image formation of the real image of the parallax image unit 2 is not required. In order to avoid an image formation operation of 2nd horizontal direction cylindrical-lens 6b, it is made to carry out image formation near the principal plane of 2nd horizontal direction cylindrical-lens 6b. By modification of the unit pixel field which forms a parallax image, the location of the playback real image 12 can be changed and the optimal real-image playback location can be further changed into the field-like playback image formation object 1 according to the image formation location of a vertical display image, the arrangement location of each cylindrical lens, etc.
[0051] (Example 2) field-like playback image formation object 1A and field-like playback image formation object 1B B and drawing 3 cross at right angles the field-like playback image formation object 1 mutually -- constituting -- the -- the 1st which intersects perpendicularly 1 horizontal cylindrical-lens 6a mutually -- horizontal -- cylindrical-lens 6aA and the 1st -- horizontal -- the example 2 constituted from cylindrical-lens 6aB is shown. the half mirror 15 which inclines 45 degrees to both in order to return said orthogonality relation to straight-line relation -- the 1st -- horizontal -- cylindrical-lens 6aA and the 1st -- horizontal -- the [cylindrical-lens 6aB and] -- it interposes on the optical axis between 2 horizontal cylindrical-lens 6b.
[0052] The 1st perpendicular horizontal cylindrical lens 5 and the cylindrical lens 7 for condensing are omitted by drawing 3 . According to this example 2, the area of the field-like playback image formation object 1 can be doubled, and a pixel consistency can be raised.
[0053] (Example 3) Drawing 4 (a) and (b) show the example 3 of the stereoscopic model regenerative apparatus of this invention. Both drawings show only unit optical system, drawing 4 (a) shows horizontal image formation relation, and drawing 4 (b) shows vertical image formation relation. In both drawings, the cylindrical lens 7 which is not related to image formation relation, 1st horizontal direction cylindrical-lens 6a, and 2nd horizontal direction cylindrical-lens 6b are omitted by each.
[0054] As for such single optical system, 300 units are constituted horizontally, and each lens group is formed in the shape of a sheet. A pixel consistency becomes high by 1st horizontal direction cylindrical-lens 6a, and cutback projection of the image of the field-like playback image formation object 1 is carried out. Thus, image formation of the projection image by which cutback projection was carried out is carried out on the image plane P by 2nd horizontal direction cylindrical-lens 6b.
[0055] Drawing 5 which omitted cutback optical system shows signs that 3 pixels carries out incidence to a pupil. If the focus of a pupil is doubled with the image plane P, three pixels X1, X2, and X3 of the real image by one unit optical unit are separated, and incidence is carried out to the pupil. Three pixels Y1, Y2, and Y3 of the real image by the next unit optical unit are separated, and incidence is carried out to the pupil. Furthermore three pixels Z1, Z2, and Z3 of the real image by the next unit optical unit are separated, and incidence is carried out to the pupil.
[0056] In the stereoscopic model display by integral photography, it corresponds to one pixel of the stereoscopic model which each parallax image unit reproduces, they are connected, and the whole image is observed. On the other hand, it separates from one optical unit by three pixels, in an above-mentioned case, is recognized, and is effective in improvement in the resolution of a reconstruction image.
[0057] When a reconstruction image deviates from on an image plane and has produced depth, a jump arises in an image in the boundary section of the reconstruction image from each unit, or a double image arises, but if there are many units, these duplex nature and a jump are seldom conspicuous, and the effectiveness by the number of image decomposition having increased is large, and can observe a good image. The case where a beam of light carries out incidence is considered from 10 pixels of a parallax image unit on a pupil.
[0058] Since it is thought that the beam of light for 10 pixels carries out incidence to a pupil from the optical-system unit whose number is one when the number of display image pixels is fixed (for example, when the number of the horizontal solution image points is 500), the number of units can be set to 1/10 that what is necessary is just to put 50 optical-system units in order. As for such percentage reduction, the optimal observation distance exists depending on the magnitude of a pupil. Even if the beam of light from an adjacent optical-system unit laps and it carries out incidence to a pupil, not much, sense of incongruity is not sensed but can take the large range of the observation distance which can display a good image by setting up optical system, as there is some overlap.
[0059] Drawing 4 (b) explains vertical image formation relation. The unit image of the field-like playback image formation object 1 is expanded by the 1st perpendicular direction cylindrical lens 5, and carries out image formation to a stereoscopic model display position. Since the lenticular sheet 7 perpendicularly diffused in this image formation side is arranged, the whole display image is observable. Equivalent [to display image size] or observation of a display image is possible also by putting a cylindrical lens with the width of face of the size beyond it on an image formation location, and condensing a beam of light in an observation location.
[0060] As mentioned above, although this invention has been described, this invention is the range which is not limited to an example and does not deviate from the essence, and it cannot be overemphasized that other various modifications are

possible.
[0061]
[Effect of the Invention] According to the stereoscopic model regenerative apparatus of this invention, it is as perpendicular as a horizontal direction, and since magnifying power is changed and image formation of the image is carried out, image size and image resolution can provide both directions with an equivalent stereoscopic model regenerative apparatus using the display of the image display device of arbitration, for example, available available marketing and popular edition.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The field-like playback image formation object of the picture reproducer which reproduces two or more parallax images (1), It consists of optical system arranged among said field-like playback image formation objects (1) and observers. Said field-like playback image formation object (1) Constitute the parallax image unit (2) located in a line in the 1st direction and the 2nd direction, and the unit of said parallax image unit (2), and it becomes the parallax of list plurality from the image (3 (m, n)) corresponding to each in said 1st direction. Said optical system is a stereoscopic model regenerative apparatus which is an anamorphic optical system (5, 6a, 6b) for having the scale factor which became independent in said 1st direction and said 2nd direction, and expanding or reducing said parallax image unit (2) according to an individual.
[Claim 2] The stereoscopic model regenerative apparatus characterized by, expanding the image of a field-like playback image formation object (1) in said 1st direction on the whole, and reducing said parallax image unit (2) according to an individual in said 2nd direction in a stereoscopic model regenerative apparatus according to claim 1.
[Claim 3] The stereoscopic model regenerative apparatus characterized by the image plane which includes the outline core of the playback image formed of an anamorphic optical system (5, 6a, 6b) in a stereoscopic model regenerative apparatus according to claim 2, and said field-like playback image formation object (1) being in image formation physical relationship.
[Claim 4] The stereoscopic model playback approach which consists of an optical projection process which expands or contracts by the anamorphic optical system (5, 6a, 6b) which the scale factor became independent of in the optical image formation process which forms the image of the shape of a field which consists of a parallax image unit with more views of the 1st direction than the number of views of the 2nd direction, and the 1st direction and said 2nd direction, and projects said image.

[Translation done.]